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1 Description of Radio Work

During the war, many of the interesting investigations conducted by the Government could not be made available for the information of the general public. The work done in radio communication was an example, but recently a number of magazine articles have appeared describing some of these investigations in a popular way. From the inquiries received, it would appear that a brief review of this work would be of general interest. The principal radio work of the Bureau during the war period was on the radio direction finder, electron tubes, and the preparation of information on radio subjects, particularly for use in the training of the personnel of the military forces. The direction finder is a relatively new device which receives radio waves and at the same time indicates the direction from which they come. It was very largely used in locating the position of enemy radio stations, both in the trenches and on the sea.

The electron tube is a device which has revolutionized the art of radio communication and has made practical radio telephony. By this means, American airplanes have been able to talk with one another while in the air. The work on the standardizing of these tubes was undertaken for the Signal Corps, and research work has been continued with a view to improving the action of these tubes and increasing the knowledge concerning such devices, as well as their field of usefulness.

Other lines of work included: the development of landing signals for airplanes, means for submarine radio communication, detecting devices, development of radio measurement, and publications dealing with radio work. These publications included both those of a technical nature - for use in colleges and among research workers on war problems - and elementary instruction material, for use in training radio operators for field work.

2 Amplifier for Radiotelegraph Receiving Circuit

A study of amplifiers for use in radiotelegraphy is in progress at the Bureau. Amplifiers are used to increase the intensity of signals, making it possible to hear very faint signals which formerly could not be received. Measurements are being made on the various amplifiers which have been developed for war use and special purposes. Work

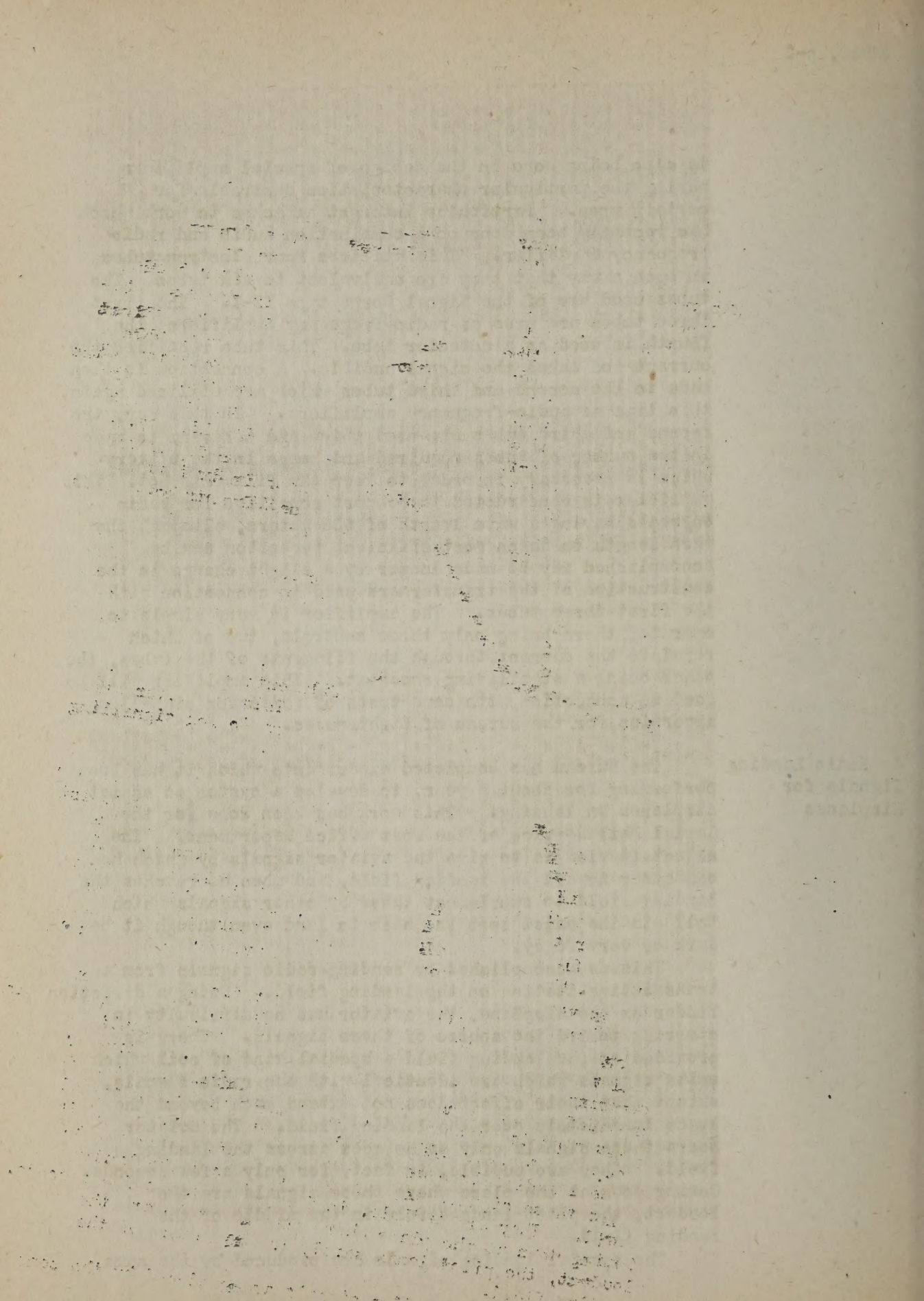
is also being done on the design of special amplifiers having the particular characteristics desirable for certain uses. Particular interest attaches to work which has recently been done on a combination audio and radio frequency amplifier. This utilizes four electron tubes in such a way that they are equivalent to six tubes. The tubes used are of the Signal Corps type VT-1. The first three tubes are used as radio-frequency amplifiers; the fourth is used as a detector tube. This tube rectifies the current and makes the signal audible. A connection is then made to the second and third tubes which are utilized again, this time as audio-frequency amplifiers. In this way, the second and third tubes are used twice and a saving is made in the number of tubes required and hence in the battery which is necessary in order to keep the filaments hot. This amplifier is constructed to be most sensitive for radio currents having a wave length of 535 meters, although the wave length on which most efficient reception can be accomplished may be made longer by a slight change in the construction of the transformers used in connection with the first three tubes. The amplifier is very simple to operate, there being only three controls, two of which regulate the current through the filaments of the tubes, the other being a stabilizing rheostat. This amplifier will be used in connection with some tests of radio fog signalling apparatus for the Bureau of Lighthouses.

3 Radio Landing Signals for Airplanes

The Bureau has completed experiments which it has been performing for about a year, to develop a system to assist airplanes in landing. This work has been done for the Aerial Mail Service of the Post Office Department. The object in view is to give the aviator signals by which he can steer toward the landing field, and when he reaches the landing field to supplement these by other signals which tell him the exact spot in which to land even though it be dark or very foggy.

This is accomplished by sending radio signals from a transmitting station on the landing field. Using a direction finder on the airplane, the aviator has no difficulty in steering toward the source of these signals. There is provided on the landing field a special kind of coil which emits signals which are identical with the radio signals, except that their effect does not extend much beyond the space immediately over the landing field. The aviator hears these signals only as he goes across the landing field. They are audible, in fact, for only a few seconds. Coming down at the place where these signals are the loudest, the pilot lands safely in the middle of the landing field.

The special landing signals are produced by the same



generating apparatus on the ground as that used for the radio signals, and the aviator receives both signals with the same receiving apparatus. In the most recent experiments, the landing signals have been heard at heights up to 6400 feet. This insures that the aviator will pick up these signals when in the vicinity of his landing place. The Post Office Department is now applying the results of these experiments and is carrying forward the development and installation of landing signal systems.

4 New Type of Radio Transmitting Set

One of the principal advances made in radio communication has been the invention and use of a device called the electron tube, otherwise known as the audion, vacuum tube, valve, pliotron, etc. Its appearance is much like an incandescent lamp bulb. It is used to detect radio signals, to magnify or amplify electric currents, and to produce radio waves. It has not been used much for the latter purpose, and the radio messages are usually sent by an apparatus using a spark of some kind. One of the advantages of the spark method was that the rapidly occurring sparks produced a tone that was readily received in the 'phones of the receiving station. There is no similar ready-made tone or anything that can be heard when the electron tube is used in place of the spark.

The Bureau has recently made a study of the above subject and as a result has developed a satisfactory radio transmitting set using an electron tube and including other improvements. Alternating current is supplied to the tube, which gives the signals a musical tone that is even better for receiving purposes than that of the old type of sets using sparks.

The sparkless method of producing radio waves has a number of advantages over the older method. One of the chief points is that the waves sent out produce much less interference, that is, the wave produces practically no effect in any receiving sets except those that are tuned to that particular wave-length. This is quite a step in advance in radio transmission. There are no moving parts in this set; the outfit is perfectly quiet in operation, and no adjustment or attention is required. An automatic key is provided, so that for such purposes as fog signalling, not even an operator is required. In preliminary tests, the set was operated in Washington and signals received in New York. The results were all that had been anticipated, in respect to absence of interference and general satisfactory operation, both at the transmitting and receiving end.

5 Cooperation of the Bureau with the American Electroplaters' Society

At the present time, electroplating is a very large and important industry. The Bureau of Standards has done considerable investigation and research in this field. In order to bring before the platers and other interested persons the results of some of this research and the possibility for further work in this direction, arrangements have been made for a member of the Bureau's staff to visit a number of the branches of the American Electroplaters' Society and to deliver illustrated lectures. In this connection, it is expected that opportunities will be offered for discussion with the platers and manufacturers regarding the possibility of manufacturers, through the American Electroplaters' Society, sending to the Bureau persons to conduct researches in this field.

6 Railroad Rail Investigation

Owing to the pressure of war work, it was necessary to temporarily abandon this very important investigation. With increasing wheel loads on all railroads of the country, a complete study of rail failures in service is an absolute necessity. Recently the Bureau has again taken up this subject. A critical study of the available literature is being made for the purpose of coordinating and classifying rail failures and test data preparatory to initiating an extensive series of experiments to discover the cause and remedy for such accidents.

7 Deep Etching of Steel

Work being carried on in connection with the deep etching of steel has been mentioned in previous numbers of the Bulletin. At a recent meeting of the American Society for Testing Materials, this subject was thoroughly discussed. Opposite views were expressed as to the meaning and nature of the defects revealed by etching. It now appears that the investigation conducted by this Bureau has definitely and conclusively proven that the following are the actual facts in the case:

Deep etching of steel may reveal chemical inhomogeneity (segregation, etc.), mechanical non-uniformity (initial stresses), and physical discontinuities. Steels which are highly internally stressed will often split open spontaneously under the action of concentrated acid. This phenomenon is similar in every respect to the "corrosion cracking" of brasses and bronze which has been previously studied. Internal fractures which may exist in steel are revealed by deep etching as the acid serves to widen and deepen the discontinuities. By means of a magnetic method, similar to that developed by the Gage section of the Bureau, it was possible to locate the defects in specimens cut from

rails which had developed transverse fissures in service. Subsequent etching showed that each defect located by the magnetic method was identical with the one revealed by deep etching. These defects are internal fractures but of such an intimate nature that they are missed entirely in a microscopic examination. It would appear that there can be no further doubt as to the influence of these defects upon the mechanical properties of steel in which they occur, but whether they occur while the metal is hot, i.e., while in the steel mill, or while cold, i.e., in the track, is an important point to be still settled. This important work in connection with that previously mentioned under the heading "Railroad Rail Investigation" should do much toward decreasing the number of such failures and accidents resulting from them.

8 Car Wheel Investigation

One of the large manufacturers of chilled iron car wheels has requested that further work be done along the line of the "graphitization of chilled iron" to supplement the information which was recently published in Technologic Paper No. 129. This material has been received and the work will be included as a part of the study of car wheels. In the near future, it is hoped to resume the determination of the magnitude of stresses set up in car wheels by the heat of braking. This investigation is of particular importance as it has been found on roads having heavy and long grades, that a great many fractures of freight car wheels occur at the bottom of such grades, the failure evidently being due to the heat generated through the long application of the brake shoes.

9 The Sulphur and Phosphorus Content in Steel

Recently a conference was held between representatives of the Bureau, the American Society for Testing Materials, and the U. S. Railroad Administration, on the question of the phosphorus and sulphur limits for specifications of various grades of steel. This question is of great economic importance due to changing conditions relating to several factors of steel manufacture, such as the gradual increase of phosphorus in available iron ores, the large amount of high sulphur scrap, and the poor quality of fuel with its high sulphur content. A tentative program of laboratory investigations and service tests has been mapped out involving the cooperation of steel manufacturers, users, and the Bureau.

10 Copper Crusher Gages

The study of aging copper cylinders, which are used for determining the pressure within a gun, has been continued. As previously mentioned, specimens have been aged at 0°, room temperature, and 100°C. The results appear

to show that the copper becomes materially softer upon aging. Naturally, this may affect seriously the indications of such cylinders when used as crusher gages, if they are to be stored for any appreciable time after compressing before use.

11 Machine Tool Investigation

In order to determine the power required, and, consequently, the efficiency of different types of cutting tools, a planer in one of the Bureau's shops has been provided with a dynamometer which accurately measures the work done during the operation of cutting. Preparatory to the research on the economy of different types of cutting tools, this dynamometer has been calibrated by dead-weight loading. Also, it is planned to study the heat treatment used in tool construction and for this purpose pyrometers and potentiometers have been calibrated and are now ready for the investigation. A comprehensive program is being worked out in connection with machine tool manufacturers.

12 Fire Tests of Concrete Columns

Twenty-eight full size columns of reinforced concrete have been constructed; 25 have been subjected to the combined fire and load test, and 7 have been tested cold, in compression. The work done has been two-fold in nature, and consists, first, of making and testing full size building columns of reinforced concrete from aggregates not previously included; and, second, in making and testing columns with protective material other than concrete. It has been found that columns made from the so-called Cow Bay gravel, a mixed gravel containing a large proportion of granite and gneiss pebbles, and columns made from pure quartz gravel gave results not quite so good as the columns made from Pittsburgh gravel previously tested. In the later column tests, the protective concrete spalled so badly early in the fire test, that a large part of the protective covering, after breaking up into slabs, fell away from the column exposing the steel and the load-bearing concrete to the fire. These columns failed under their working load before the completion of the 4-hour fire test. On the other hand, columns in which the coarse aggregate was trap rock showed no tendency to spall or crack seriously in the fire tests and retained more than half of their original strength as determined by load tests made while the columns were at maximum temperatures at the end of the 4-hour fire test. The results shown by columns in which the coarse aggregate was blast furnace slag were similar to those with trap rock aggregate.

13 Experiments on Methods of Column Construction and Production

Since it has been found that concrete columns using gravels of three different types show much less resistance to fire than columns of limestone, trap rock, or blast furnace slag, an effort has been made to develop practical methods whereby columns from gravels of these types, which are in very extensive use, can be so protected as to resist fire as well as or better than columns from the other aggregates, without any additional cost of construction. In order to do away with the excessive cost of steel or wood forms, columns have been cast in gypsum forms which are also allowed to stay in place as a protection against fire. Forms of this style with a light binder of expanded metal or of poultry netting have been found to stay in place throughout the 4-hour fire test and to afford excellent protection. Gravel concrete columns so protected withstood the test much better than trap rock and slage concrete columns made in the usual way. It has been found that columns can be made without the usual steel or wood forms by wrapping metal lath around the spiral reinforcing steel and casting the concrete in that. The results indicate that no great difficulty should be experienced in making columns in this way, if concrete of medium consistency is used.

14 Protective Plasters for Columns

Several columns have been made and tested in which a part of the protective covering has been formed of plaster made of Portland cement and sand. These columns gave better results than gravel concrete columns from the same aggregate made in the usual way, but not as good as those made from trap rock and slag. The difficulty with this form of protection is that the outer coat or coats of plaster fall off under fire conditions leaving the column with insufficient protection. Considerable work has been done in the study of plasters for the protection of gravel concrete columns and for other purposes. It has been found that within certain limits mixtures of gypsum, hydrated lime, and kieselguhr give workable plasters of superior heat insulating properties. One column, which had been cast in expanded metal over spiral reinforcement, was covered with approximately 1" of a mixture of these materials. Poultry netting was placed over the second coat, and concealed by a third coat. A finish coat of gypsum and hydrated lime was used. In the fire test, only the finish coat came off. The total thickness of protective material on this column was approximately 2-1/2", and the thermal protection was so effective that the higher temperature measured in the steel was but 185°C as against 410°C in the steel columns protected by 2-1/2" of material in the form of concrete covered by cement plaster.

15 Grading of Indiana Limestone

A number of porosity and compression tests are being made on standard specimens of Indiana limestone. These tests are to establish further data for the preparation of specifications for this material, and to furnish a more definite basis for the grading of this stone. To date, 72 porosity determinations have been made and 30 compression tests completed.

16 Discoloration Tests

A number of panels of different grades of Indiana limestone are being erected in a position where they will be exposed to the weather. These panels are approximately three feet square and consist of a four inch facing of limestone and a brick backing. Various mortars and different methods of waterproofing will be used in setting up the panels. The object of this experiment is to determine the cause of the discolorations which are so frequently seen in structures built of this material.

17 Frost Action Tests

Freezing tests have been made on 15 samples of commercial sandstone. Several of these withstood 300 freezings with but few signs of disintegration, while the poorer grades were completely broken down by less than 100 freezings. One sample of granite passed 300 freezings without showing any signs of frost action, while a sample of porous limestone began to disintegrate at 150 freezings.

18 Expansion of Marble

Three freshly quarried slabs of marbles were accurately measured and then exposed to the weather on the roof of one of the Bureau's buildings. These tests were started last March and are to determine the effect of such exposure on the dimensions of the pieces. A considerable change of dimensions was shown by all slabs during the first three months, after which the dimensions remained fairly constant. Two slabs of Tennessee marble expanded; one 0.02% and the other 0.13% of its length. A slab of Vermont marble contracted 0.04% of its length.

19 Motion Pictures of Reversal of Stress Tests of Reinforced Concrete Beams

The tests made by this Bureau for the Concrete Ship Section of the U. S. Shipping Board on reinforced concrete beams, to determine the effect of reversing the loadings, have attracted such wide attention that a motion picture of a beam under test, with two strainographs attached, has been made. Three views were taken; the first showing the two strainographs in operation; the second showing the entire reversal of stress machine with the strainographs, and the third a close-up view of the middle portion of the

beam showing the opening and closing of the fine cracks in the concrete with the reversal of the loading.

The graphs, as given by the strainograph, show that the reversal of load machine is very accurate, as each graph is an exact counterpart of all others. The uniformity of these graphs clearly indicates the resilient properties of reinforced concrete. During the long series of tests, the strain gage measurements indicated a slight momentary impact effect, and then a constant load for a period of from 1-1/2 to 2 seconds. This fact is clearly brought out by the curves of the strainograph charts, which show a decided peak for the beginning of the load. This peak continues only a small fraction of the time of loading, the curve becoming uniform for the remainder of the time.

20 Effect of Cal and Calcium Chloride on the Strength of Concrete

In view of the favorable results obtained in the preliminary tests on Cal as an accelerator of the hardening of Portland cement mixtures, it was considered desirable to make further tests in concrete, and, at the same time, to make parallel tests using calcium chloride as the accelerator.

The outline of the tests requires the making of 324 6"x12" cylinder test pieces, one-third of which are to be broken at each period, 2 days, 7 days, and 28 days. The proportions are 1:1-1/2:3 and 1:2:4. All mixes of each proportion are of the same consistency. That of the first is rather stiff, while that of the last is considerably wetter, thus the ranges of proportions and consistencies of mixes in which an accelerator is apt to be used are fairly well covered. In order to study the effects of the accelerators on different brands of cement, identical tests were made on three brands. With each cement and proportion, three percentages of accelerator were used, 0%, 5% Cal, and a percentage of calcium chloride solution containing an equivalent amount of chlorine as in the 5% Cal. These percentages are on the basis of the weight of the cement. The test pieces from each batch were divided for storing in damp sand and air. Therefore, the effects of the two storages are strictly comparable.

Incidental to the tests, time of set determinations on accelerated and unaccelerated concretes using the flow table method were made, and it was found that the accelerated concretes reached the point of no flow or set at an earlier time than the unaccelerated concretes.

At the present time, progress in the tests has been made to the extent that all test pieces have been molded and a considerable number have been broken, However, no conclusions can be formed from the data on hand at this time.

21 Air Analysis Work

During the month, a mechanical analysis was made on a sample of plaster-of-paris with the air analyzer and with sieves. The object of the analysis was to study the action of the plaster in the analyzer. The results indicate that the particles of plaster are broken up by the air in the analyzer, that is, the particles apparently disintegrate and break up into still smaller particles under the action of the air, so much so that about 81% of the plaster was blown off by the No. 1 nozzle, while only about 70% would pass the 200-mesh sieve. To compare with normal cement, a sample of which 70% passed the 200-mesh sieve, there would probably be about 25% blown off by the No. 1 nozzle of the air analyzer.

A sample of zinc oxide and a sample of lithopone were submitted by the Chemical Division of the Bureau for sieve analysis. These materials are used for mixing with rubber and it was desired to investigate the effect of the fineness of the materials on the properties of the rubber compounds. Practically all of both samples passed the 330-mesh sieve, and, therefore, no indication of the fineness gradation of these materials may be obtained by means of sieves. The zinc oxide stuck and clogged the sieve very badly and required a great deal of time to pass through. The lithopone passed through the sieve more readily but it also stuck and clogged to some extent.

22 Tests of Precision Weights

The number of weights received for test during September dropped considerably below that of the past two months and the number of tests completed was considerably increased. As a consequence, more tests were completed than were received, which is gratifying, as for some time this work has been much delayed. Considerable study has been given to the small assay balance, errors in which have caused considerable hindrance in the routine testing. Some black lacquer on the rider bar and a little on the bows of the scale pan appears to have been the cause of the most serious shifting of the zero with the changing humidity in the air. This lacquer was removed and several parts of the operating mechanism were given a much needed readjustment. Preliminary work done on this balance gives hopes of it now being satisfactory, and as soon as the calibration is completed, it will again be put to regular use.

23 Tests of Volumetric Apparatus

Testing of glass volumetric apparatus was continued during the month and a complete set of specific gravity hydrometers (22 in all) were tested at 5 points on each

scale for a large manufacturing concern, for use as their primary standards. Thirteen gallon capacity measures of 37 submitted by another firm were tested and found to have errors in excess of the tolerances allowed. A number of pipettes, burettes, flasks, and cylindrical graduates have been delivered to the Bureau by a company which intends to enter the field of precision glassware. A representative of this firm also called at the Bureau for a few days' experience in observing the methods employed in testing the apparatus. All this work has now been completed and the apparatus returned to the maker.

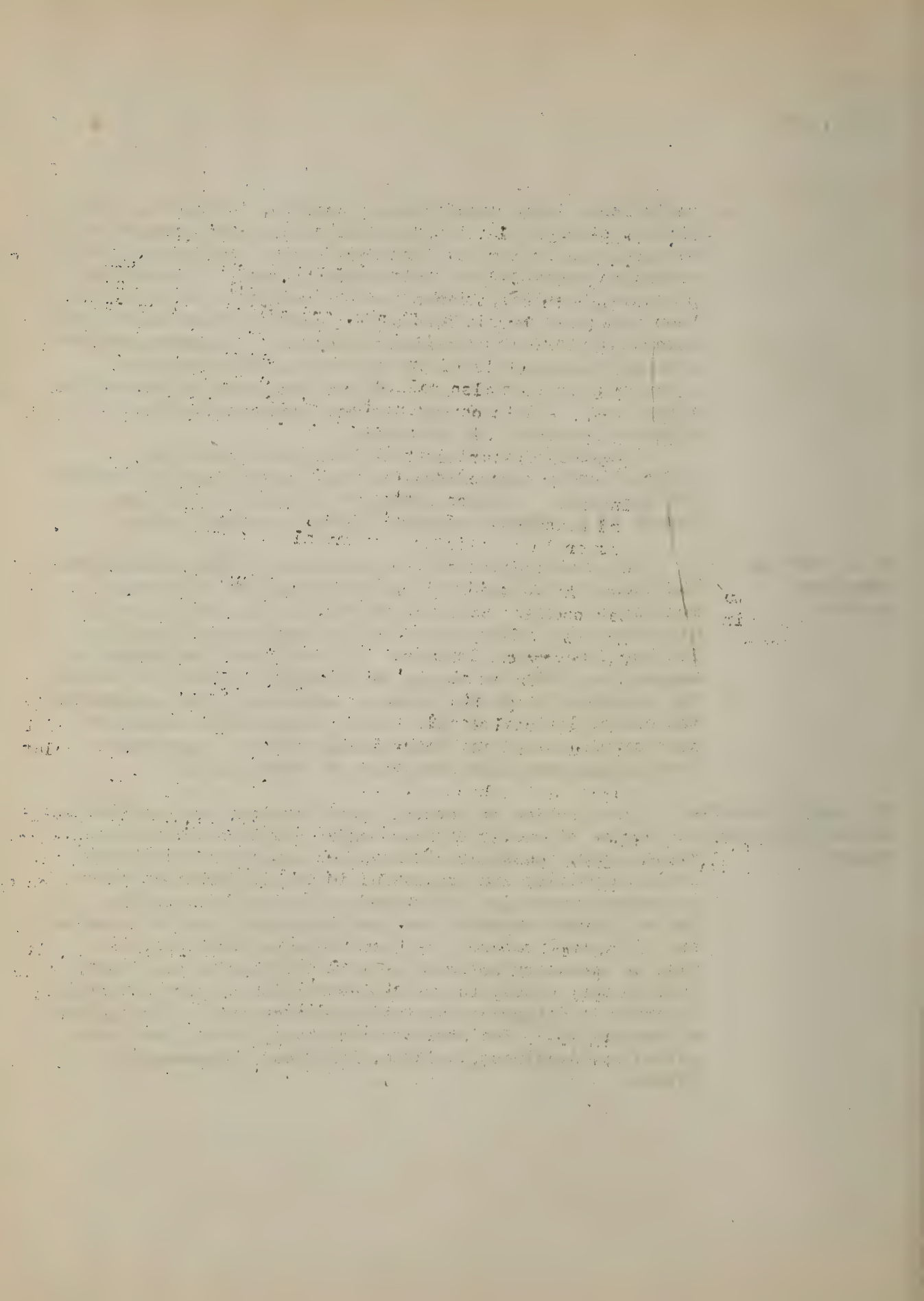
A number of visitors have been given specific information in connection with work in the field of weights and measures. In most cases, the Bureau was able to answer in a satisfactory way all the questions asked.

24 A Study of Fish Skin Leather

An investigation of the structure of fish skin leather has been started and will probably continue for several months at least. It is hoped that it will result in the discovery of a quick method of distinguishing fish skin leather from animal leather. In this work the Bureau is cooperating with the Bureau of Fisheries, which will supply the material for test. Quite an extensive field exists for the use of leather of this kind, though there should be some simple method for determining whether a particular leather has been made from fish or animal skin.

25 Purity Specifications for Rare Sugars

The problem of forming specifications for establishing the degree of purity of rare sugars has been undertaken. These sugars and sugar alcohols are usually obtainable in small quantities and are useful in the differentiation of pathogenic bacteria. The study is being made for the Medical Supply Depot of the War Department, but the results are of general value. To form the specifications, it will be necessary not only to test the samples submitted, but, in many cases, to prepare quantities of pure materials in order to determine the fundamental constants for purposes of comparison. The samples which have already been submitted are Arabinose, Dulcite, Raffinose, Rhamnose, and Xylose.



26 Technological Assistance Sought in the Manufacture of Sugar and Syrups

Representatives of the Cane Growers' Association of Louisiana, who recently visited the Bureau, have requested that two members of the Polarimetric Section be sent to Louisiana to assist in the solution of technologic and chemical questions relative to the manufacture of sugar and syrups.

27 Investigation of Spectral Transmissivities of Dyes

The present pronounced interest in the development of the industry has emphasized the need of accurate and reliable data on the properties of dyes. Dyes owe their color to, and are characterized by their remarkable selective absorption for light of different frequencies (spectral colors), that is, light of certain spectral colors is freely transmitted by the dye, while light of other spectral colors is strongly absorbed. The color of the dye is a composite effect of the various spectral colors and so it happens that two dyes which match in lamp light may not match in daylight. To insure a match in all lights, the "transmissivities" of the dyes for all spectral colors must be the same. For the purposes of identification and analysis of the dyes, reliable data on the transmissivities for a wide range of frequencies - even outside the visible spectrum - are of recognized importance, but little information of this sort is available. During several years past, the Bureau has been making extensive and elaborate preparation for a systematic investigation to obtain such data. This preliminary work is now finished and the investigation proper, in cooperation with the Bureau of Chemistry, has been in progress for a month or two. The Bureau of Chemistry is providing known analyzed samples and the Bureau of Standards is determining spectral transmissivities at various temperatures and concentrations throughout the visible and into the ultra-violet and infra-red. The dyes just at present in the course of investigation are the "permitted food colors". Others will be taken up as rapidly as the work can be done. It is expected that the whole investigation will extend over a period of years more or less continuously; but partial reports will be issued from time to time, as the data are available. The data will be in the form of tables and curves giving the specific transmissivities over a wide range of frequencies in the form which will be convenient for the practical purposes of the dye analyst as well as for theoretical discussion of the nature of absorption and its relation to constitution. It is hoped that the first of these reports can be submitted for publication this Fall.

28 Films Formed on the Optical Surfaces of Service Instruments

It is a very common experience in tropical climates to have optical instruments rendered unserviceable by dust deposits and fungus growth on the glass surfaces, and even devitrification of these surfaces to such an extent that the instruments become wholly useless. The alternate condensation and evaporation of the moisture inside the instrument is no doubt the contributory cause of these films. The same thing happens, though not to the same degree, in the more temperate climates. Many of the war optical instruments manufactured in this country were rendered unserviceable by such films, especially field instruments, where the films were deposited on the reticules. At the request of the Ordnance Department of the Army, an investigation has been undertaken by the Optical Instruments Section to learn, if possible, the causes of these films and the means for preventing their formation.

29 Tests on the Constancy of Precision Gages and End Standards

Precision end gages, which are steel blocks with two opposite faces, plane, parallel, and a specified distance apart, are used as master gages for precise mechanical work. These gages are made so nearly perfect that it is impossible to determine their errors with any contact micrometric apparatus. Apparatus and methods which make use of the interference of light waves must, therefore, be employed in their calibration. For the purpose of detecting any changes which might be taking place in their length, the Optical Division has calibrated, relative to the standard light waves, during the past year, several sets of gages to be used as secondary standards. During this time, several thousand gages were compared, for different manufacturers, with these secondary standards, and, to determine their constancy, a large number of these gages were retained at the Bureau and tested from time to time. Most of these remained remarkably constant. Some 2-, 3-, and 4-inch ones, however, changed in length from two to six-thousandths of an inch in a few months. Although changes of this magnitude are too small to be detected with certainty by any micrometric instrument and are, therefore, negligible when the gages are used in mechanical work, they are very important in the case of secondary standards.

Some experiments have been carried out to test the immediate effect of relatively large temperature variations on gages. For this purpose, several gages were cooled to liquid air temperature and then brought back to 20°C. Some returned to their original length within a few millionths of an inch; but one 3-inch gage was found to be 0.0022" longer, and one 4-inch 0.0023" longer after

treatment. Several were heated to different temperatures and allowed to cool to 20°C. One 2-inch which had been heated to 110°C was found 0.0002" longer; and one 4-inch heated to 200°C, 0.0017" shorter after being carried through the temperature cycle. Of three gages heated to 300°C, two regained their original length exactly, while one 4-inch increased in length 0.0005". In those cases where large changes took place, it seems probable that strains must have existed in the material which were relieved by the large changes in temperature.

With the object of finding the most permanent material, the Metallurgical Division has undertaken the work of applying different heat treatments to several kinds of steel. The first length measurements on over 300 of these samples were made during the past month.

30 Different Thermal Expansivities for the same kind of Gages

The linear thermal expansion coefficients of a large number of gages have been determined and found to vary from 11×10^{-6} to 13×10^{-6} per degree Centigrade. It is very necessary, therefore, in making accurate comparisons of long gages to have them, when used, very near the specified temperature of 20°C.

31 Forces Necessary of Separate Gages in Intimate Contact

Measurements have been made on the forces necessary to separate gages which had been brought into close contact. A large number of tests showed that 25 to 35 lb. per sq. in. were needed to separate gages whose surfaces had been given the ordinary finish. With gages whose surfaces had been given a high optical polish and tested for planeness by the optical method of interference, forces as high as 100 lb. per sq. in. were required. A large number of tests show that the separating film between gages that have been carefully brought into contact is less than 2 millionths of an inch.

32 Investigation of Substitutes for Jute Burlap for Sand Bags and for Camouflage Work

At the request of the War Department, the Paper and Textile Sections of the Bureau will undertake an investigation of substitutes for jute burlap for the making of sand bags and for camouflage work. Jute burlap will be used as a standard and the substitutes must at least equal it in strength and durability. It is desired to obtain a material produced in this country, so that there will always be a large supply on hand. Sisal hemp and low-grade cotton fabrics, reinforced paper, crinkled and smooth paper will be tested. The investigation will comprise both laboratory and field tests which will be intended to duplicate service conditions. Samples of available materials are being obtained and the investigation will be started as soon as these are received.

33 A Study of Dyes to Distinguish between Sulphate and Sulphite Fiber in Paper

A large number of requests have been received for a test of stains or dyes suitable for use as a means of distinguishing between sulphate and sulphite fiber in paper. Sulphate fibers are those which have been cooked by the "sulphate process" of making wood pulp, while sulphite fibers are those treated by an acid sulphite solution while cooking. The name refers to the process by which the pulp is made rather than to the type of fiber structure or kind of tree from which it was obtained. Authentic samples of sulphate and sulphite fibers are being obtained with complete information as to their source. These samples will be treated with various stains and dyes and it is hoped that a selective stain will be found that will clearly distinguish between the two types of paper when examined under the microscope.

34 Specifications for Lubricating Oils

In connection with the investigation of lubricating oils, a member of the Bureau's staff attended a meeting of oil refiners and consumers and members of the American Society for Testing Materials, recently held in Canada. The general opinion at this meeting was that particular attention should be paid to simplicity of apparatus and methods of test adopted as a standard. It appeared that test methods were now sufficiently standardized to warrant the Society in making a start toward the writing of satisfactory specifications for lubricating oils. Quite a large number of inquiries have been received concerning details of the test methods in use and for explanation of certain features of the various government specifications for lubricants.

Respectfully,

S. W. STRATTON

Director

HGB